

RESEARCH PAPER

Distribution of the European mole cricket *Gryllotalpa gryllotalpa* (Orthoptera) in Slovakia

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Abstract

Gryllotalpa gryllotalpa is widely distributed in the lowlands and hilly regions of southern, western, eastern Slovakia, outside the mountains as the High and Low Tatras. It was found at 516 sites, including 136 sites (5.3% of 2,561 studied sites) which were recorded using regular Orthoptera mapping of primary habitats in 1994–2021 and 380 other sites acquired from a questionnaire survey in 2020 and 2021. Altogether 72 % of the records were collected below 350 m a.s.l., and 98% below 700 m a.s.l. The habitat structure was biased by the result of questionnaire survey (recording mainly secondary habitats), with gardens (> 70%, n = 516) being the most frequent habitat. During regular Orthoptera mapping of primary habitats the most frequently inhabited environments were wet grasslands, marshes (42 %) and meadows (30%, n = 136). Suspected occurrence of the closely related species *G. stepposa* was investigated at nine lowland sites in southern Slovakia (6 in the Danube River area and 3 in the Ipel' River area) in 2020 and 2021, but all the determined males (11) belonged to the species *G. gryllotalpa*. Distributional patterns of the species in Slovakia have been compared with neighboring countries of Europe.

Keywords

biogeography, Orthoptera, altitudes, primary and secondary habitats, Slovakia.

Introduction

The European Mole-cricket *Gryllotalpa gryllotalpa* (L.) (Orthoptera: Gryllotalpidae) is widely distributed from North Africa over large parts of Europe to West Asia (Harz 1969). In Europe it is found from the Iberian Peninsula, Italy and the former Yugoslavia in the south to England, south Sweden and northwestern European Russia in the north (Hochkirch et al. 2016). This mostly subterraneously living species is found in moist habitats, often with sandy soils, such as marshes, swamps, wet meadows, along ditches and also in gardens and farmland (Detzel 1998, Massa et al. 2012). It is considered one of the most destructive insects affecting crop due to the damage extending to all stages of vegetation and causing a significant decrease of production. The percentages of yield losses due to the infestation by *G. gryllotalpa* were 22.5%, 20.5%, 18% and 18.9% on cowpeas, sunflower, okra and potato, respectively (Al-Jassany and Al-Joboory 2016). Therefore, it is important to monitor *G. gryllotalpa* infestation to minimize economic losses by using effective control methods in the gardens and fields.

In Slovakia, the species is mentioned historically as one of the first species of Orthoptera, at least since the beginning of the 19th century (e.g. Ocskay de Ocskö 1826, Frivaldszky 1868), probably due to its economic importance. Recently it has been listed as a not very frequent species in the Checklist of Orthoptera of Slovakia (Krištín et al. 2020), probably due to its elusive lifestyle. In Slovakia and the Czech Republic, it was considered an important pest of field crops and seedlings in forest nurseries in the past (Obenberger 1926, Pfeffer et al. 1954). The overall population trend is decreasing in Europe and particularly in the northern part of its range the species has lost many subpopulations (Hochkirch et al. 2016). Therefore, the information on the distribution and possible damage needs to be updated regularly. Due to its subterranean way of life, the species is not well registrable by conventional orthopterological mapping methods and requires the specific survey methods focused mainly on acoustic monitoring and underground tunnel mapping. Therefore, the species is often missing in the records of regular survey studies on the Orthopteran fauna.

In several countries of southern and eastern Europe, as well as the neighboring Hungary, near the Slovak border, a related species was found a few years ago, morphologically distinguishable *Gryllotalpa stepposa* (Iorgu et al. 2016, 2017, Bogdanović 2017). Hence, the northern and western borders of the *G. stepposa* range and distribution in the Western Carpathians are unclear for the moment. This fact increased our attention in Slovakia to further inspection of individuals at least along the southern border with Hungary.

Based on the above mentioned, in this work we focused on the following goals: i) to update the knowledge on the distribution, altitudes and habitats of the species in 1994–2021; and ii) to check the possible occurrence of *G. stepposa* in southern Slovakia in 2020 and 2021.

Material and Methods

Data on the distribution and habitats of the species come from two sources, namely: i) from the regular mapping of Orthoptera of Slovakia, where the database included 2,561 sites from primary habitats (about 40 thousand datapoints), and 136 location data on *G. gryllotalpa* and ii) from questionnaire survey, where we obtained the data from a total of 380 localities (from 348 mappers, see Acknowledgment). Mainly the overall results on the habitat are partly influenced by the questionnaire survey (380 out of 516 locations). The respondents provided the most data from the secondary habitat of the gardens, which could partly affect the result of the distributional patterns. The abundance of the species is difficult to estimate due to its secret way of life. For the estimation we used semi-quantitative categories (1 = 1–2 individuals, 2 = 3–10 ind., 3 = >10 ind.). More accurate quantitative data were limited and obtained only from three sites in central Slovakia, where we used acoustic monitoring of singing males per 100 m² and the counting of nests by digging 10 m² (20–30 cm deep) in each area (beginning June 2020 and 2021).

Furthermore, the potential occurrence of the familiar species *Gryllotalpa stepposa* was verified at nine locations in southern Slovakia in 2020–2021, at sites and habitats similar to those in the neighboring Hungary (Iorgu et al. 2016). The shape of the chitinized part of the epiphallus, the inner part of the hind tibia and the density of the stridulatory teeth on the male tegmen were examined in all 11 *Gryllotalpa* male specimens (cf. Iorgu et al. 2017).

Results and discussion

Distribution and abundance

The species was found at 516 sites of Slovakia in 1994–2021 (Figs. 1, 3). 136 of the total number of sites (5.3% of 2,561 mapped sites) were registered during the mapping of the primary habitats of Orthoptera of Slovakia in 1994–2021 and another 380 sites were recorded in the questionnaire survey in 2020 and 2021, mainly in the secondary habitats. The species could not be found in the mountain areas of Western Carpathians (High and Low Tatra Mts., Malá and Veľká Fatra Mts., Orava area) and in the northwest and north of central Slovakia. The apparent absence of the species along the Tornaľa - Revúca - Poprad towns belt, we would explain by the lack of data sampling in the given area.

The lowest abundance (1–2 ind. per site) was found on the most sites (79.5%). The highest abundance (> 10 ind. per site) only at 27 (5.2%) of the total 516 recorded sites. During the regular mapping of primary habitats of Orthoptera of Slovakia, we found only five sites (3.7% of 136 sites) with the highest abundance (> 10 ind. per site) and the most sites (61%) with the lowest abundance category (1–2 ind.) In the

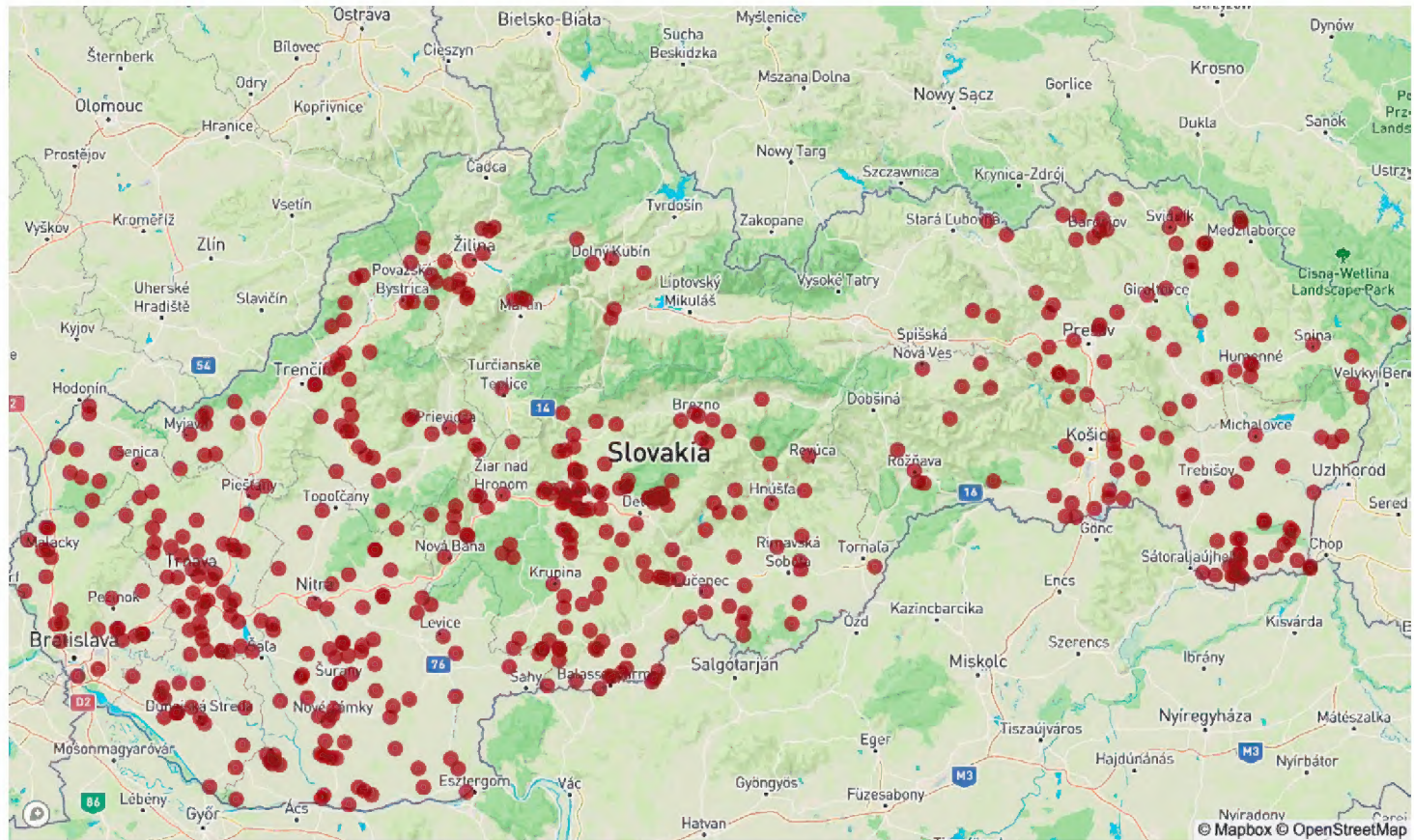


Figure 1. Distribution of *Gryllotalpa gryllotalpa* in physical map of Slovakia in 1994–2021.

questionnaire survey, serious damage to vegetables and plants in gardens was reported in 22 cases (5.8% of 380 sites). Using the acoustic monitoring and counting the number of nests on three sites of central Slovakia, we found the highest abundance of 2–3 calling males /100 m² and the highest nest density of 4–5 nests/ 10 m² in the habitat of extensively managed gardens.

The distribution of the species in the southwest of Slovakia is joined with a continuous population in eastern Austria (Zuna-Kratky et al. 2017). In the south it touches populations in Hungary and in the Balkans (Iorgu et al. 2016). In the north, in Poland, the species is distributed relatively evenly throughout the country (Żurawlew et al. 2021), but on the border with Slovakia it connects to our territory only in the northeast of the country, confirming our results on the absence of the species in the northwest and north of central Slovakia (cf Fig. 1).

Altitudinal distribution

The species was found mainly in the lowlands and hilly regions (the mean altitude was 270 ± 161 m a.s.l., $n = 516$ sites). It occurs from the lowest regions of the country (98 m a.s.l.) in East Slovakian lowland (SE Slovakia), up to 963 m a.s.l. (mountain pastures in Stolické vrchy Mts. in Central Slovakia). A total of 55% of the records have been collected below 250 m a.s.l. (median = 217 m a.s.l.), 30% between 251 and 450 m a.s.l., only 7% above 550 m a.s.l. and only 2% above 700 m a.s.l. (Fig. 2, 3).

In comparison, e.g. in the neighboring well-mapped Austria, the species is most widespread between 400 and 500 m a.s.l. (40%), and up to 94% of data is up to 700

m a.s.l. (Zuna-Kratky et al. 2017). Different altitudinal distribution could be probably explained by the different geomorphology and more southern position of the country.

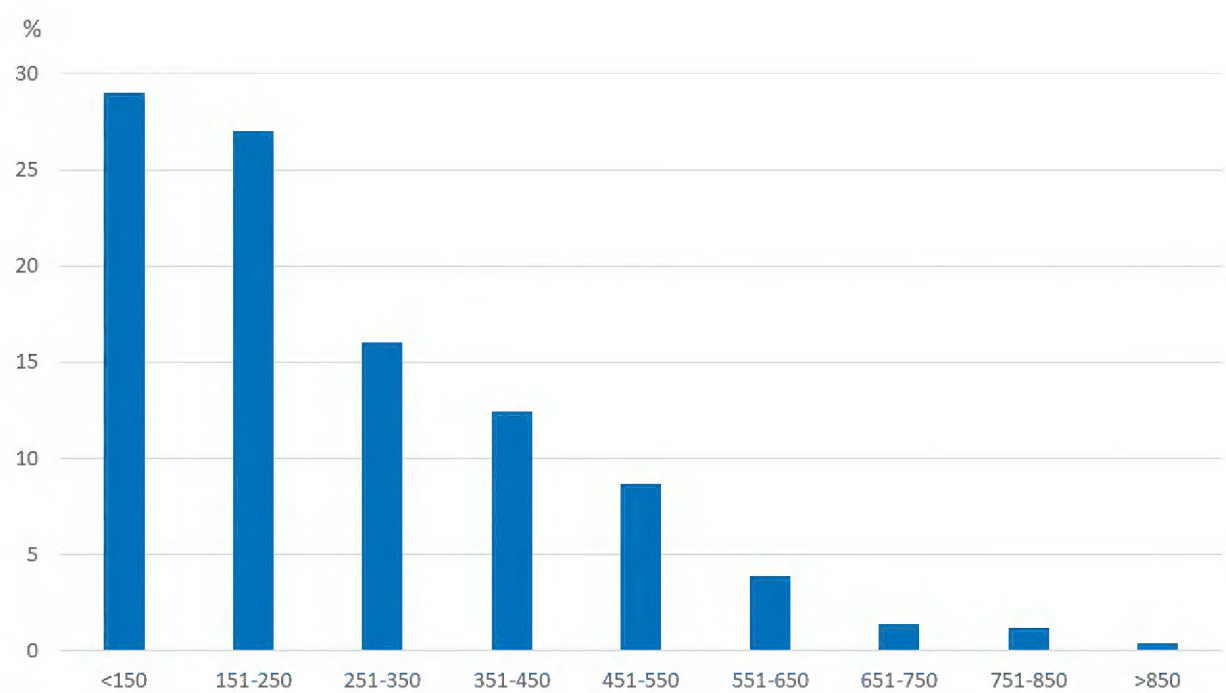


Figure 2. Altitudinal distribution (m a.s.l.) of *G. gryllotalpa* (F%, n = 516 sites) in Slovakia in 1994–2021.

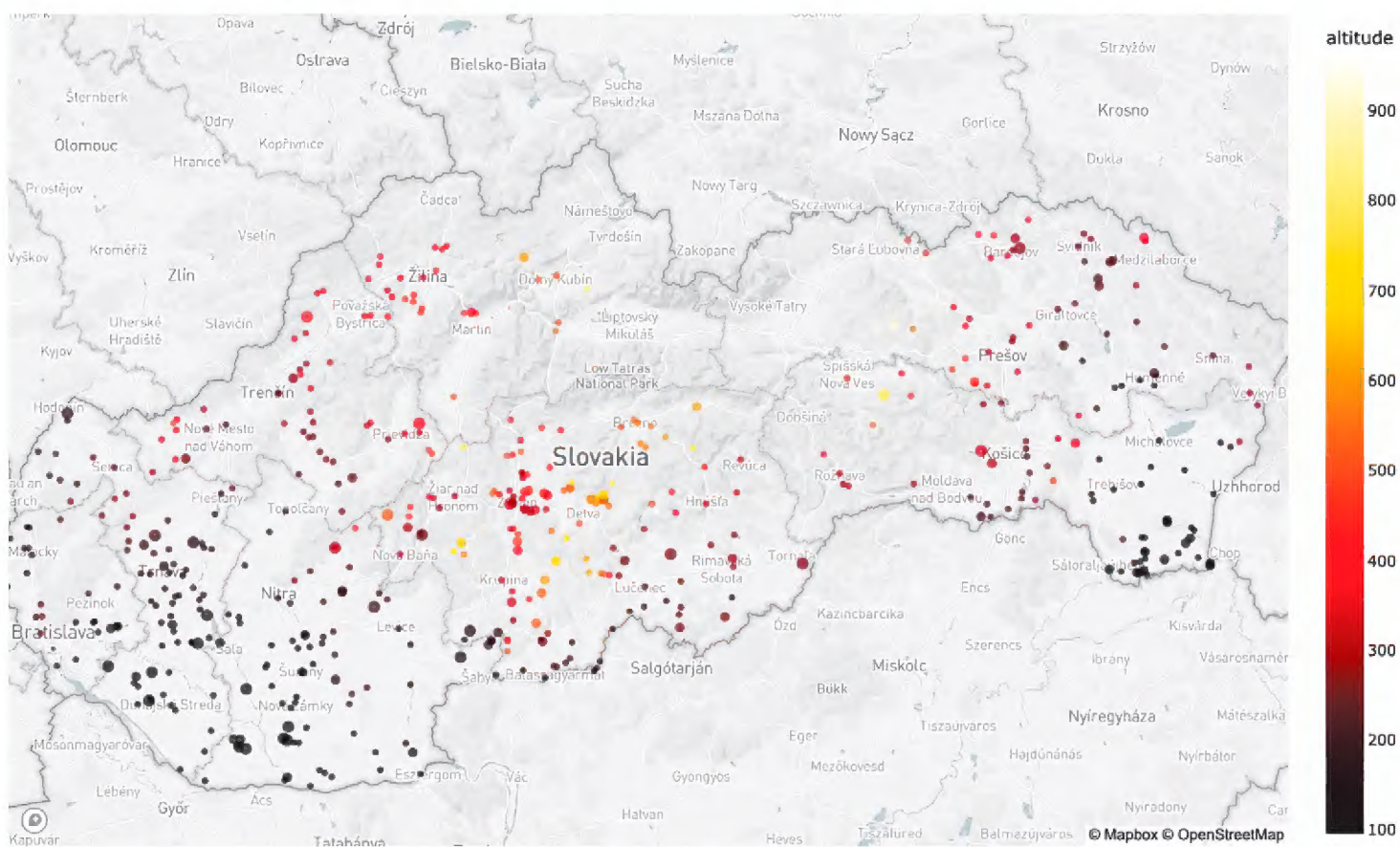


Figure 3. Altitudinal distribution (m a.s.l.) of *G. gryllotalpa* in Slovakia in 1994–2021 (size of dots shows the semiquantitative abundance; small <2 individuals, middle 3–10, big >10; the colors show particular altitudes).

Habitats

Habitat analyses of the species from all 516 sites show that the species occurs mainly in the secondary habitat of gardens (>70% of localities, Fig. 4). However, if we consider only 136 sites of the species found by regular mapping of Orthoptera of Slovakia (where mainly primary natural habitats were mapped) without a questionnaire survey in 2020–2021, the most important habitats of the species were wetlands and wet meadows (42% of locations), and meadows (almost 30%, Fig. 4).

For example, In Austria, the species was found mainly in meadows (25%) and wetlands and wet grasslands (22%) (Zuna-Kratky et al. 2017).

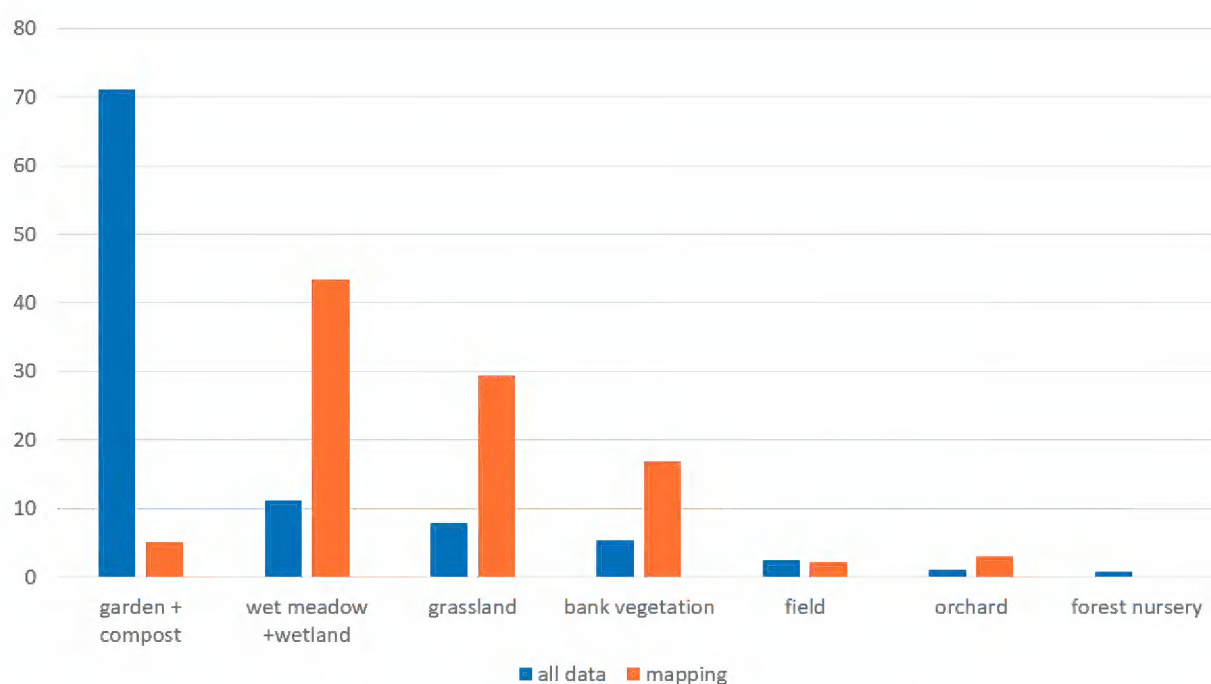


Figure 4. Habitats of *G. gryllotalpa* in Slovakia (in %, blue = all 516 sites; orange = only primary habitat mapping data, n= 136 sites).

Verification of the occurrence of *Gryllotalpa stepposa* in southern Slovakia

Nine lowland sites in the wet grasslands, gardens and wetlands of Danube River area (6 sites) and Ipeľ River area (3 sites), along the border with Hungary, were inspected in 2020 and 2021 for the possible occurrence of the closely related species *G. stepposa* in Slovakia, but all of the determined males (6 from Danube area, 5 from Ipeľ River area) belonged to the species *G. gryllotalpa*.

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